Observing the Evolution of Typhoon Wakes

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LONG-TERM GOALS

The long-term goal of this work is to observe, understand, quantify and parameterize upper-ocean mixing for use in global ocean modeling.

OBJECTIVES

The objective of our research program is to observe the temporal and spatial evolution of typhoon cold wakes, in particular we directly observed the mixing associated with turbulence generated by the strong air-sea interaction in a typhoon. These observations will be used to make quantifiable assessments of mixed layer models under the extreme conditions of a typhoon. We also observed the restratification of the cold wake from air-sea fluxes and lateral mixing by sub-mesoscale eddies.

APPROACH

We made these observations from a ship-based survey of the evolution of the typhoon cold wake that was undertaken to observe the restratification and collapse of the wake after the passage of a typhoon in the Western Pacific Ocean. The cold wake survey utilized a towed profiling sensor and a tethered turbulence package. Also, we utilized by newly developed Seagliders with microstructure sensors to examine the structure of the coldwake.

WORK COMPLETED

The planning of the observational field program was the focus of the work completed until this past year, with several meetings of the Impact of Typhoons On the Pacific (ITOP) and Tropical Cyclones Study 2010 (TCS2010) investigators haven taken place. The integration and testing of microstructure sensors on the gliders was also completed. This year we completed the observational phase of the program. Daily teleconferences between ITOP and TCS2010 investigators lead to the decision to conduct the cold wake survey cruise in Typhoon Fanapi. All of the observational assets were marshaled, and a successful cruise was undertaken to sample the cold wake.

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RESULTS

The observational field program was completed this fiscal year. After waiting for a typhoon of sufficient size and intensity to form, the decision was made sample Typhoon Fanapi. The R/V Revelle got underway the full science party just 1 day after Fanapi passed over Taiwan.

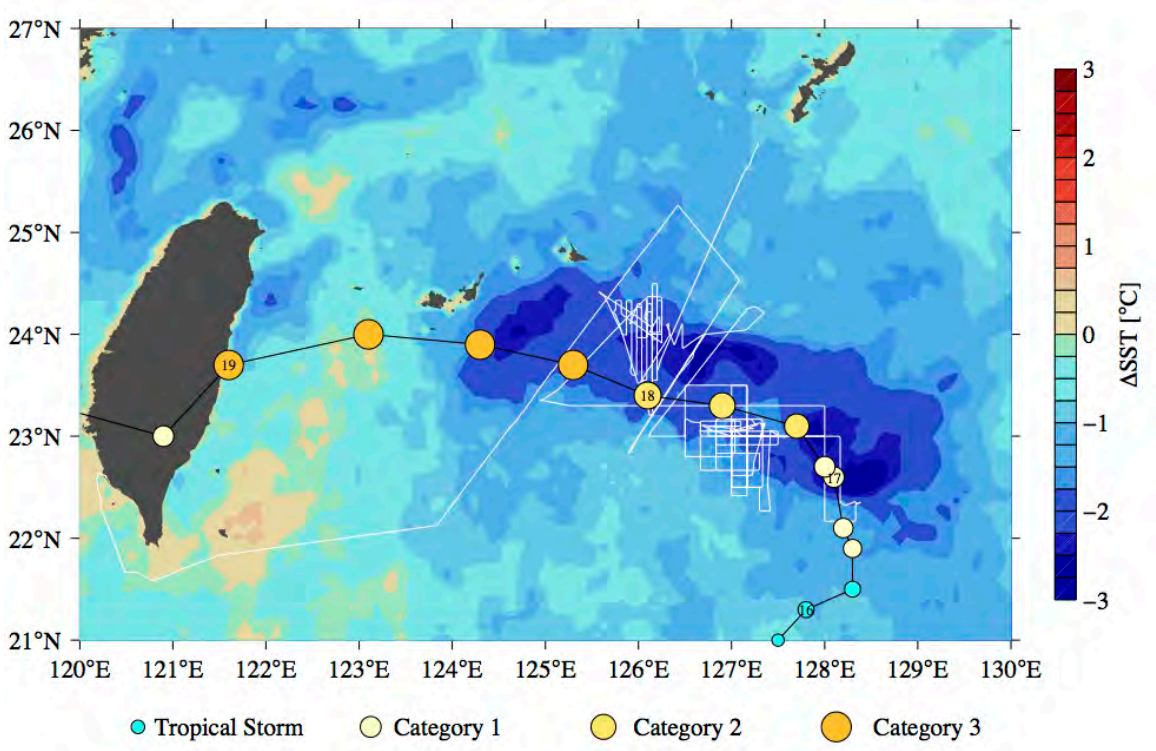

Figure 1 shows the cruise track of the cold wake cruise overlaid on top of the sea surface temperature difference between pre-Fanapi period (September 13-15, 2010) and the post-Fanapi period (September 19-21, 2010).

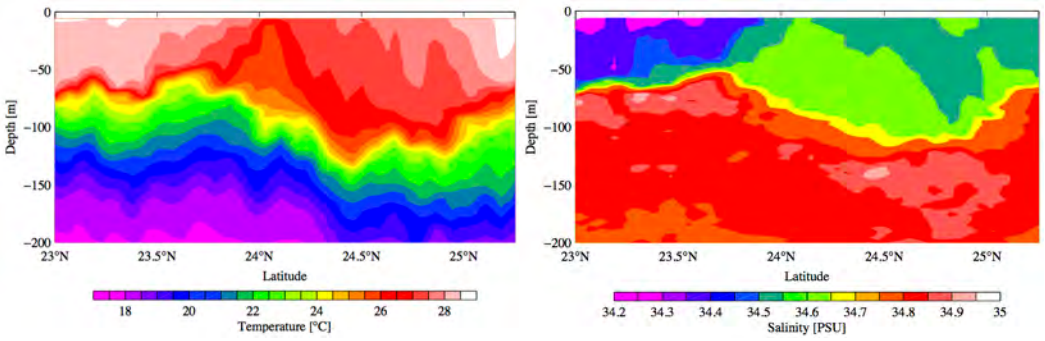

Figure 2 shows the vertical cross-section of the first crossing of the cold wake with temperature in the lefthand panel, and salinity on the right. They show the mixing of the water from below the mixed layer upwards by the strong mixing during the typhoon.

IMPACT/APPLICATIONS

The technical problem of integrating and testing microstructure sensors on gliders was implemented, and the field program offered an excellent opportunity for using these technical developments to study an important scientific problem while providing a new measurement capability to the oceanographic community. These novel observations are now being analyzed.

RELATED PROJECTS

Related to this project is my work in understanding and parameterizing mixing in global ocean models, such as the Community Earth System Model (http://www.cesm.ucar.edu/), and an NSF funded Climate Process Team on the same subject (http://www-pord.ucsd.edu/~jen/cpt/).